Regional HOT Lanes Network Feasibility Study

APPENDIX A

DESIGN GUIDANCE FOR USE IN EVALUATION OF HOT LANE CORRIDORS

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Introduction

This brief working paper summarizes design guidance to be applied in the focused evaluations and cost estimating activities for selected Bay Area HOT lane corridors in Task 22. The purpose of this guidance is to apply the same related practices as have been undertaken in Alameda and Santa Clara Counties to date as they implement HOT lanes on specific freeway corridors. This experience reflects extensive partnering dialog with representatives from the respective CMAs, Caltrans and CHP as they have attempted to achieve the best and most practicable HOT lane design for each corridor. This working paper builds on the earlier Task 16 working paper addressing recommended design principles summarizing national and state design guidance applicable to contiguous managed lane treatments.

Meetings were held with ACCMA, VTA, Caltrans District 4 and the California Highway Patrol local divisions in August and September to review recent HOT lane designs and design issues commonly encountered, in order to achieve an understanding of best practice[1]. The guidance in this paper and preliminary layouts resulting therefrom are not intended to substitute for the evaluations typically performed as part of the environmental reviews or the Project Study Report process, but are intended to generate a more realistic estimate of project cost at an early stage in the development of a regional HOT lane program.

Preferred Design Components

The following represent Caltrans District 4's preferred design components for contiguous single-lane Bay Area HOT facilities, either converted from HOV lanes or added in freeway corridors without HOV lanes.

[1] Disclaimer: This working paper is not intended to represent a consensus among all agency representatives for the guidance described. Differences of opinion exist within and between interviewed agencies and their representatives. This working paper will be amended as further discussions are held. The guidance presented is intended to represent the most appropriate set of assumptions to be applicable to the Bay Area HOT lane study during Phase 3 evaluations being conducted at this time.

- 12-ft lane widths (applies to the HOT lane, ingress/egress merge lanes
- and general purpose [GP] lanes)
- 2-ft buffer (4 ft is desirable if this dimension can be maintained for the entire corridor)
- 10 ft left side shoulder next to median barrier
- 10 ft right shoulder (no exceptions except at pinch points)
- Separate ingress and egress areas
- Transition lanes will be provided as part of each ingress or egress area to allow for the orderly diverging and merging of traffic to and from the HOT lane
- In the vicinity of designated ingress and egress areas, minimum weaves per lane of 200m (600 ft) per mainlane weave upstream and downstream of respective ingress and egress location which is reflected in the current Caltrans HOV Guidelines. The exact location of the determination of the weave distance is as follows:
    - For entrance ramp to the HOT lane, from the nearest upstream right side ramp where ramp taper joins the mainlanes to the beginning of the solid stripe leading into the lane.
    - For exit ramp from the HOT lane, the distance from where the HOT lane exit ramp stripe tapers to join the left mainlane edge stripe to the right side full ramp separation (e.g. gore point) of the next downstream exit ramp from the mainlanes.
- Where the HOT lane begins, the lane is a lane addition to the left of the existing general purpose (GP) lanes; an existing GP lane does not become a restricted lane.
- Where a HOT lane ends, it is either terminated as a lane drop or extended as a GP lane beyond the HOT lane.
- No traffic channelizers, pylons or other raised “soft” barriers will be considered within the designated buffer area. CHP is interested in facilities that are self-enforcing, and so some form of barrier to keep drivers from weaving across the buffer would be desirable. Other strategies, including strategic placement of

readers and cameras, and other strategies that similarly discourage buffer crossing, should be considered.

Design Trade-offs

Although all projects will need to go through a Project Study Report and analysis specific to each corridor, a general approach to potential trade-offs was developed based on meetings with Caltrans, CHP, and the local Congestion Management Agencies. In locations where all of the above design attributes will not fit within the available right-of-way, the following trade-offs will be applied in the sequence indicated:

1) Based on the current Bay Area design experience, the outside shoulder is the one design feature that should not be universally compromised. Right side shoulders should nominally be 10 ft in width and 14 ft in spot locations to aid in CHP enforcement. At isolated pinch points shoulders may be reduced for short distances. Such pinch points could be long viaducts and overcrossings with columns that preclude full shoulder continuity. There is no universal response to this condition since the PSR and environmental process typically reviews what is acceptable in such settings. No outside or inside shoulders should be considered for any typical sections which are between 4 and 8 feet, because these present major safety hazards to motorists (these may exist as residual widths for isolated pinch points).
2) Outside lanes used by trucks should be 12 ft, which are typically the rightmost two lanes.
3) HOT and faster GP lanes can be reduced to no less than 11 ft (typically the #1 and #2 HOT and GP lanes). Transition lanes can be no less than 11 ft between HOT and GP lanes at access locations. Trade-offs for lane widths including the HOT lane should work from left to right.
4) The left shoulder next to the median barrier can be reduced from 10 ft to no less than 2 to 3 ft, depending on the location of drainage inlets, columns and other obstructions, and horizontal and vertical curvature.
5) The buffer between the HOT and general purpose lanes can be reduced to 1.5 ft in isolated locations (but still must accommodate three pavement stripes).

6) Limited reductions around bridge columns are not subject to these trade-offs if reductions are less than about 1000 ft in length. Other site-specific considerations may apply in such locations.

Options to Above

Programmed and existing general purpose auxiliary lanes between successive right side ramps may be considered as conversion candidates to add a new HOT lane within a freeway, or to fit specific preferred design attributes within the corridor if there is general concurrence that the overall operation is improved in making this trade-off.

Special consideration is needed near major interchanges and project termini where there are different HOV and HOT restrictions. If volumes are anticipated which are greater than about 1000 vehicles per hour (vph), then the lane in which HOVs or tolled vehicles are forced out should be extended long enough to adequately handle the weaves or extended as a free lane and a lane drop accommodated on the right further downstream.

If the minimum design cannot fit within available right-of-way, then the affected segment will be highlighted for specific discussions with Caltrans to determine if any HOT lane design is feasible before further analysis is undertaken.

Ingress and Egress Design

Tapers and overall configuration should match layouts developed for I-680 HOT lanes. (No standard templates from Caltrans are available.)

Each ingress zone should contain a sign in advance of the entrance posting the current prevailing toll rate, which can include travel time information as well, on a hybrid sign panel involving VMS elements. Only one pricing sign per entrance is required.

Further discussions are required to outline a sequence of trade offs for cases where demand suggests ingress or egress locations are required in an area that cannot accommodate a transition lane within readily available right-of-way, even after exploring the trade-offs listed above. Options could include: (1) attempt to locate ingress/egress location within reasonable proximity of the desired location; (2) choose not to provide ingress/egress through the constrained location, which may have political and

operational impacts; (3) explore potential for continuous access design through the constrained location (not part of the current study); (4) explore the potential to allow restricted access without transition lanes (also not part of the current study). Any such guidance will need to take into consideration the length of the constrained section as well as traffic demand. Development of these guidelines will be pursued through review of specific corridors in the Phase 3 study.

Enforcement Provisions

Based on current state statute, CHP is required to stop and apprehend violators on the right side of the freeway where a continuous shoulder is provided. Otherwise they are subject to potential liability.

CHP prefers that the HOT lane be self enforcing to the extent possible, and for this reason they are interested in any electronic monitoring and enforcement capability that can be designed into the roadway infrastructure to address toll violations, access violations (i.e., illegal crossing outside designated access zones), and occupancy violations for free vehicles. Occupancy detection and related statutes continue to present challenges and for the foreseeable future will still require officer presence on site.

CHP preferences include widened areas of the right shoulders where safe monitoring and apprehension can occur, and/or areas off the freeway which can augment safe apprehension and issuance of citations.

CHP traffic monitoring locations should also be included on the left side near tolling zones and other places where officer visibility can be afforded and officer safety promoted through the use of barrier offsets or other design techniques which protect the parked CHP vehicle. Such sites are preferred immediately downstream of a toll reader site for CHP monitoring.

Each toll reader and camera site should contain beacons which distinguish who has paid and be able to be viewed for up to 500 feet in either direction.

Enforcement considerations should include not only full 10-ft outside shoulders, but also wider pull-outs on the right side of the freeway, monitoring sites on the left with offsets in the median barrier and other safe places to apprehend and cite violators on the right

side of the GP lanes (10 ft shoulders or wider pull-outs where feasible). Illumination should also be provided in the vicinity of the toll zones.

Such design provisions will be augmented by other strategies including on-board mobile monitoring equipment to aid CHP in determining whether the vehicle has paid a toll or has an active account.

Application of the Guidance

The following discussion provides examples of how guidance found in the working paper should typically be applied to corridor investigations. The purpose of these investigations is to provide a close approximation of the likely outcome from a Project Study Report (PSR) and Project Report (PR) for each new or converted HOT lane corridor. These reports typically examine the full cost required to achieve recommended design standards and document prudent deviations from these standards. The significant number of HOV projects implemented in California primarily over the last 23 years provides a good reference of experience from which to base what will typically be acceptable. However, in any corridor there are significant differences that may result in different directions and approvals that may ultimately be granted. Further, the level of constraint for some Bay Area corridors is such that there may be little opportunity to meet most of the frequently accepted deviations.

Conversion Segments

The existing HOV lane designs and HOV lanes under construction or currently approved and programmed through the PSR/PR process should be assumed without any further expansion or widening except as will be required to provide transition lanes at separate ingress and egress zones. Some examination of the outside shoulder should be considered to see if full shoulders exist or if pull-outs can be added with a minimum of cost.

New Segments

The following guidance is offered for new segments where HOV lanes do not currently exist. To the extent possible, new right-of-way (R/W) should be avoided, in order to achieve the best fit involving the trade-offs illustrated. While

it is not always possible to determine the limits of available R/W, judgment should be applied to arrive at what appears to be R/W limits from available aerials.

Open Medians: To the extent possible, open medians should be the first place to consider widening, and widening should fill in the median as a typical condition to meet preferred design attributes. This means that all undercrossings and other grade separations and crossings shorter than about 500 ft should be widened to match the preferred typical section.

Undercrossings: Typically undercrossings are widened. Exceptions would be if there is no way of meeting the preferred design on either side of undercrossing due to other constraints, or if widening the undercrossing to meet all preferred design elements is not possible. If only selected elements of the preferred design can be accommodated with undercrossing widening, then do not pursue widening as a recommended expenditure.

Overcrossings: While all overcrossings may warrant pinch point designation and thus be saved, about 20% have been replaced as part of HOV widening when the following conditions were evident: the overcrossing required all design reductions on the trade-off list and still resulted in a hazard to traffic, was less than 50 ft in width and the age of the structure was more than 40 years and beyond its functional life. These conditions should be examined from available aerial data to determine if there is high likelihood of salvaging the overcrossing. There may also be an opportunity to place local access ramps behind the mainlane column envelope.

Retaining/Soundwall Sections: Retaining wall sections of less than about 20 ft in height should be considered expendable and replaced if R/W allows for the preferred design to be provided with a higher wall. Existing soundwalls should be retained unless there is available R/W behind the soundwalls that can provide for the preferred design. In such case the soundwalls would be replaced. If only selected elements of the preferred design can be accommodated with wall relocation, then do not pursue this recommended expenditure.

Local Interchanges

Minor clips of new R/W may be required at ramp gores and merges if outside widening is required for the typical section to fit. Design reductions should only be pursued if the R/W impacts several sensitive or high-cost parcels based on aerials, there are a number of expensive retaining walls that would require rebuilding, or the typical section will not fit within the typical R/W provided. Context to surrounding conditions also plays a role. If widening upstream/downstream of the affected location will preclude the preferred section to be provided, then this will temper whether it is worth doing a spot widening at an interchange.

Freeway-to-Freeway Interchanges

Seek to avoid any modification of interchange connectors, including reductions that may include no right side shoulders around isolated structures. While the analysis does not budget for any interchange reconfiguration study in order to accommodate HOT lanes, if there appears there is an opportunity to move certain ramps behind columns or make other roadway reconfigurations to improve the typical section, these should be noted in a comment box on the layout sheet.

Access Treatments

Using the concepts developed for I-680, attempt to place access locations where widening can be provided within available R/W. Try to place access locations on tangent sections. In order to maximize the mainlane weave distances, the best location to place merge lanes may be in the middle of existing local access interchanges so that upstream/downstream weaves to the next available interchange are served. The merge lane may replace the space normally reserved for an inside shoulder. While no guidance has been given regarding reductions in 115:1 tapers, many access treatments may benefit by locating them so that an extension of an existing mainlane horizontal curve acts to create a shorter taper distance.

Enforcement: As for the conversion segments, account for some outside spot widening in costs to provide for places for CHP to pull motorists off

the freeway. Consider illumination (two lights and poles) as part of any toll zone cost.